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(54) Method and device for control and delivery of digitally compressed visual data in a heterogeneous communication network

(57) A method and apparatus automatically manipulates a digitally compressed video bitstream such that the result is compatible with different bandwidth and error resilience requirements at a receiving point in a heterogeneous communication network. The method and device provide for analysis of bitstream header information to determine its relevant coding syntax parameters. Feedback from the receiving point on the network is then used to identify error robustness requirements for an intermediate bitstream. The bitstream is then manipulated by an error robustness regulator to achieve error protection in the network. The bitrate requirements of the network establish a selection of relevant and irrelevant bits from the bitstream The present method and device include identification of irrelevant and low priority video bits; intentional introduction of packet losses to reduce bitrate while maintaining visual quality; use of replacement tags for irrelevant and low priority components of the bitstream for compatible decoding by a wide array of decoders; and insertion of resynchronization tags and translation of predictively coded video packet bits for the improvement of error resilience.

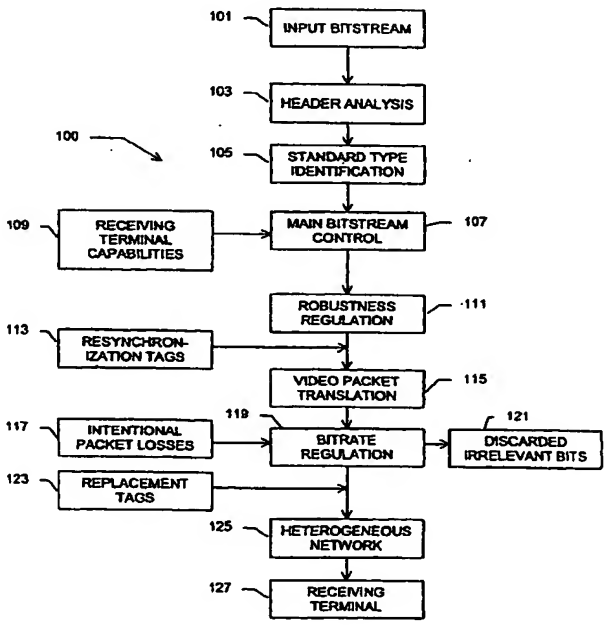

FIG 1

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Description

Field of the Invention

[0001] The present invention relates to automatically managing the delivery of digitally compressed visual data, and more particularly, to a device and method for controlling the bitrate and error robustness of digitally compressed video bitstreams in a heterogeneous communications network.

Background of the Invention

[0002] With the advent of new communication systems, it has become possible to communicate digital visual information and data in addition to just voice services efficiently. Such new communication systems comprise both wireline and wireless networks. In the context of wireline networks, packet and circuit switched communication systems have been developed in both the private and public domains for wide and local area coverage. As part of packet-based communications, a significant amount of data is exchanged between local area networks, such as those which are part of a corporate infrastructure, and wide area networks, such as the public Internet. Services to guarantee Quality of Service (QoS) have emerged in this realm to support visual and multimedia communication.

[0003] New wireless systems have also been developed to support the transmission of information at higher bitrates than previously possible. These wireless systems conform to international cellular communication standards, and consist of digital communication air-interface standards using Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA). An example of widely deployed TDMA communication is the Global System for Mobile communication (GSM). CDMA forms the basis for the third generation cellular communication standard IMT-2000.

[0004] Most of these communication systems (wireline and wireless) have been designed to allow for the exchange of a maximum amount of information between users connected within the infrastructure of each system and those using devices outside that infrastructure. For example, IMT-2000 protocols can support data communication from wireless terminals to terminals residing on packet switched wireline systems. Moreover, within these communication systems, terminals, or clients, may connect to other terminals, acting as servers, at different bitrates depending on their location in each system. This leads to the concept of *heterogeneous communication networks*, which are networks consisting of diverse or dissimilar connections yet often communicating similar information.

[0005] Problems arise when considering the communication of visual information in heterogeneous networks. A first problematic issue which arises is that visual information, and, in particular, digitally compressed video signals, require substantially more bandwidth than comparable voice signals compressed over similar time intervals. Transmitting visual information between systems designed with different nominal transmission bitrates presents some difficulty because of delays that result from these incompatible bitrates. In addition, varying error characteristics of the different communication systems in a heterogeneous network also present a problem for the transmission of visual information because it is very difficult to mask errors in the visual space.

[0006] These problems do not alone make up the difficulties with communicating visual information over diverse systems. Services designed to exploit the communication of visual information in heterogeneous networks must, necessarily, rely on the existence of digitally compressed video. Therefore, not only creating new content, but exploiting existing content is a primary focus for the further development and success of these services. For one-way visual applications, there is already a substantial amount of digitally encoded content for training and entertainment that could be delivered to mobile subscribers on a wireless network, or to clients connected at dissimilar rates on a wireline network. Existing, or "legacy" video material is primarily encoded using the ISO MPEG-1 and MPEG-2 standards, although legacy content also exists in the form of the ITU-T H.261 and, to a lesser extent, H.263 standards. This material can have high value to new multimedia services, while at the same time lead to the acceptance and use of new visual coding standards such as ISO MPEG-4.

[0007] One problem with the delivery of legacy data over the low bandwidth wired and wireless networks is that the original encoded bandwidth typically exceeds the capabilities of the network, assuming that there is a maximum delay restriction on the delivery of that data. For example, some wireless mobile systems may have multimedia terminals supporting MPEG-1 decoding, but the channel rates to the multimedia enabled mobile terminals may be as low as 64Kbps. In this case, the MPEG-1 material, encoded at 1.5Mbps, would require substantial buffering delay time before playback could begin. Unless most of the sequence was to be downloaded first, stalling would occur, as the decoder's buffer would empty much faster than it would fill. It is also unlikely that a mobile terminal would be able to provide sufficient memory for buffering long sequences. A requirement exists, therefore, to successfully manipulate this type of high bitrate data to a lower rate such that it is compatible with a low bandwidth connection on the network.

[0008] As a result of the arrival of new wired and wireless communication systems with the capacity to transmit and exchange visual information, there is a significant need for a method and device designed to manage the visual content being delivered over these networks. In particular, technology is needed to auto-

matically manage the bitrate and error robustness of pre-existing digital video bitstreams so that they can be delivered in a compatible form to users at arbitrary nodes in a heterogeneous network.

Summary of the Invention

[0009] Briefly, therefore, this invention provides a method and apparatus for changing a digitally compressed video bitstream at a source point in a network, in an automatic way, such that the resulting bitstream is compatible with different bandwidth and error resilience requirements at a receiving point in a heterogeneous communication network. The novel method consists of analyzing the header information of the original bitstream to determine its coding parameters. Feedback from the receiving point on the network is then used to determine error properties of the network. The bandwidth and error resilience requirements establish a prioritization and selection of relevant and irrelevant bits from the original bitstream, of which the relevant bits are manipulated by a robustness regulator to achieve error protection in the network. The principal inventive components of the method include identification of irrelevant and low priority video bits, intentional introduction of packet losses to reduce bitrate, use of replacement tags for irrelevant and low priority components of the bitstream, and insertion of resynchronization tags for the improvement of error resilience.

Brief Description of the Drawings

[0010]

FIG. 1 is a block diagram of a bitstream regulation system operative to manipulate an incoming bitstream and output a bitstream compatible with a receiving terminal in accordance with an embodiment of the present invention.

FIG. 2 is a generalized flow diagram of a preferred embodiment of a method for regulating a bitstream encoded with scalable information to produce a bitstream compatible with a receiving terminal in accordance with the present invention.

FIGS. 3A, 3B and 3C illustratively provide examples of insertion of resynchronization tags into a bitstream and translation of differentially encoded components within a video packet to support robust decoding.

FIGS. 4A and 4B illustratively provide examples of insertion of replacement tags into a bitstream after bitrate regulation to preserve the decoded quality at a compatible receiving terminal.

FIG. 5 illustrates a block diagram of a preferred embodiment of a device for manipulating bits in a bitstream of encoded video data to produce a bitstream compatible with a receiving terminal in accordance with the present invention.

Detailed Description of the Preferred Embodiments

[0011] The present invention is more fully described with reference to FIGS. 1 - 5. FIG. 1 illustrates a block diagram 100 of a visual bitstream regulation method which defines a control system operated in the manner described herein. The input bitstream 101 is passed through a header analysis stage 103 which extracts information about the type of standard used to create the bitstream. This information is passed through the standard type identification stage 105, which results in the assignment of control parameters in the main bitstream control 107 which is coupled to accept input parameters describing the receiving terminal's capabilities 109. These steps are designed to set up the system for proper regulation and compatible delivery of the bitstream from the sender to the receiving terminal. In particular, identification of the original visual coding standard used to encode the bitstream coupled with information about the capabilities of the receiving terminal determines the extent to which the bitstream must be manipulated before compatible communication is possible.

[0012] The output of the main bitstream control step is coupled to the robustness regulation stage 111. In this stage, the bitrate-regulated bitstream is modified to provide a bitstream which is compatible with the error characteristics of the channel connecting the source and receiving terminals. This robustness regulation is dependent on the standard type of the original bitstream identified in 105. The regulation is accomplished through the packetization of bits in the coded frames of visual information in such a way that errors may be detected, localized and concealed by a robust decoder. The use of resynchronization tags 113 is applied for visual bitstreams conforming to standards which support sub-frame resynchronization. The robustness regulation step manipulates the bitstream such that independent decoding is possible for each segment of bits delimited by the inserted resynchronization tags. In the case of predictively coded information, this information is replaced with equivalent information utilizing only predictors within the same segment. This stage is referred to as video packet translation 115. For example, this would apply to the replacement of codewords for motion vector differences computed across resynchronization segments with motion vector differences computed from information in the same segment.

[0013] The output of the video packet translation step is directed to the bitrate regulation stage 119 which is coupled to receive intentional packet loss information 117 and, additionally, to discard irrelevant bits 121 in order to reduce the bitstream bitrate. The purpose of the bitrate regulation stage is to adjust the bitrate of the input bitstream so that the delivered stream is compatible with the capabilities of the receiving terminal and its delivery channel. This is accomplished through manipulation and removal of bits in the incoming bitstream. The

matically manage the bitrate and error robustness of pre-existing digital video bitstreams so that they can be delivered in a compatible form to users at arbitrary nodes in a heterogeneous network.

Summary of the Invention

[0009] Briefly, therefore, this invention provides a method and apparatus for changing a digitally compressed video bitstream at a source point in a network, in an automatic way, such that the resulting bitstream is compatible with different bandwidth and error resilience requirements at a receiving point in a heterogeneous communication network. The novel method consists of analyzing the header information of the original bitstream to determine its coding parameters. Feedback from the receiving point on the network is then used to determine error properties of the network. The bandwidth and error resilience requirements establish a prioritization and selection of relevant and irrelevant bits from the original bitstream, of which the relevant bits are manipulated by a robustness regulator to achieve error protection in the network. The principal inventive components of the method include identification of irrelevant and low priority video bits, intentional introduction of packet losses to reduce bitrate, use of replacement tags for irrelevant and low priority components of the bitstream, and insertion of resynchronization tags for the improvement of error resilience.

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FIG. 1 is a block diagram of a bitstream regulation system operative to manipulate an incoming bitstream and output a bitstream compatible with a receiving terminal in accordance with an embodiment of the present invention.

FIG. 2 is a generalized flow diagram of a preferred embodiment of a method for regulating a bitstream encoded with scalable information to produce a bitstream compatible with a receiving terminal in accordance with the present invention.

FIGS. 3A, 3B and 3C illustratively provide examples of insertion of resynchronization tags into a bitstream and translation of differentially encoded components within a video packet to support robust decoding.

FIGS. 4A and 4B illustratively provide examples of insertion of replacement tags into a bitstream after bitrate regulation to preserve the decoded quality at a compatible receiving terminal.

FIG. 5 illustrates a block diagram of a preferred embodiment of a device for manipulating bits in a bitstream of encoded video data to produce a bitstream compatible with a receiving terminal in accordance with the present invention.

Detailed Description of the Preferred Embodiments

[0011] The present invention is more fully described with reference to FIGS. 1 - 5. FIG. 1 illustrates a block diagram 100 of a visual bitstream regulation method which defines a control system operated in the manner described herein. The input bitstream 101 is passed through a header analysis stage 103 which extracts information about the type of standard used to create the bitstream. This information is passed through the standard type identification stage 105, which results in the assignment of control parameters in the main bitstream control 107 which is coupled to accept input parameters describing the receiving terminal's capabilities 109. These steps are designed to set up the system for proper regulation and compatible delivery of the bitstream from the sender to the receiving terminal. In particular, identification of the original visual coding standard used to encode the bitstream coupled with information about the capabilities of the receiving terminal determines the extent to which the bitstream must be manipulated before compatible communication is possible.

[0012] The output of the main bitstream control step is coupled to the robustness regulation stage 111. In this stage, the bitrate-regulated bitstream is modified to provide a bitstream which is compatible with the error characteristics of the channel connecting the source and receiving terminals. This robustness regulation is dependent on the standard type of the original bitstream identified in 105. The regulation is accomplished through the packetization of bits in the coded frames of visual information in such a way that errors may be detected, localized and concealed by a robust decoder. The use of resynchronization tags 113 is applied for visual bitstreams conforming to standards which support sub-frame resynchronization. The robustness regulation step manipulates the bitstream such that independent decoding is possible for each segment of bits delimited by the inserted resynchronization tags. In the case of predictively coded information, this information is replaced with equivalent information utilizing only predictors within the same segment. This stage is referred to as video packet translation 115. For example, this would apply to the replacement of codewords for motion vector differences computed across resynchronization segments with motion vector differences computed from information in the same segment.

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stream in order to guarantee accurate decoding at a receiving terminal. The introduction of replacement codeword bits 231 accomplishes this task in the next step of the method. In a preferred embodiment as shown by the flow diagram 200, resynchronization packets are dropped in step 223. FIGS. 4A and 4B further describe the inserting of replacement information for two scenarios of dropped MPEG-4 video packet information in accordance with this preferred embodiment. In the first example 401 shown in FIG. 4A, bits associated with the texture coding part of a video packet are dropped by the bitrate regulator 217 in FIG. 2. Portion 401a of the first example identified an original data partitioned video packet bitstream; and portion 401b represents video packet bitstream with replacement tags. The bits dropped, which are delimited by a unique motion marker, are associated with the spatial prediction error codewords (CBPY, DQ, DCT), which decode to values applied to a spatial portion of a video frame after motion compensation has been applied. This information is the lowest priority component of an MPEG-4 video packet. While this example illustratively provides details for the syntax of MPEG-4, the identical concept applies to the video syntax of the MPEG-2 standard. In example 401, replacement bits are inserted into the bitstream in the form of code words for zero valued prediction error coefficients (CBPY',DQ',DCT'). These codewords require negligible bitrate in relation to the bitrate consumed by the dropped bits. A more extreme case of the same concept is illustrated in example 403 shown in FIG. 4B, where data partitioning is not present in the incoming bitstream. Portion 403a of FIG. 4B represents an original combined motion texture video packet bitstream; and portion 403b represents video packet bitstream with replacement tags. In this case, all of the bits associated with the payload of the video packet are dropped. The video packet header remains and is used to indicate the bounding macroblock information for the video packet. The replacement bits used are the codewords for combined motion and texture information for blocks containing no motion and no prediction error information (CBP'). This is referred to as "NOT CODED" codewords in example 403. Again, as in example 401, the bitrate consumed by the replacement bits is negligible in comparison to the bitrate consumed by the original video packet under consideration.

[0025] Continuing with the description of the preferred embodiment of the present method described by FIG 2, a bitrate regulated bitstream is output at 233 from the bitrate regulation stage. The output bitstream is delivered to the heterogeneous network 237 for subsequent decoding at the receiving terminal 239.

[0026] FIG. 5 illustrates a diagram of a device 500 for manipulating a digitally compressed video bitstream to produce an output bitstream compatible with the bandwidth and error resilience requirements of heterogeneous communications network. The device 500 comprises a header analysis unit for determining a standard type and a syntax used to compress the input bitstream 501 coupled to a main bitstream controller 505. A header analysis unit 503 is coupled to receive input from a memory module holding a list of predetermined standard header codes 504 enabling the analysis unit to compute the present standard and syntax by exhaustive matching of header bits. The main bitstream controller 505 is a means for discarding selected bits from the input bitstream on the basis of the syntax determined in the unit 503. The main bitstream controller 505 comprises a robustness regulation module 509, a bitrate regulation module 511, and a replacement tag generator 515.

[0027] The robustness regulation module 509 is a means for inserting predetermined bits into the bitstream to improve the error robust localization and decoding of the bitstream in accordance with the standard type and syntax determined in the unit 503. The robustness regulation module 509 also translates any predictively coded information into codewords relying only on bits within the present video packet in accordance with inserted resynchronization markers. Operation of the robustness regulation module 509 is reliant on signals from the header analysis unit 503 and feedback from the receiving terminal 507, which are both coupled to input to the main bitstream controller 505 containing those modules.

[0028] The output of the robustness regulation module 509 is coupled to input to the bitrate regulation module 511, which is a means to discard selected bits 513 from the bitstream on the basis of the standard type and the syntax determined in the unit 503. The bitrate regulation module 509 is a means for dropping low priority bits associated with frames in an enhancement layer of a scalable bitstream, and means for discarding packets of low priority bits associated with segments in a packet of video bits delimited by resynchronization markers or picture headers. The bitrate regulation module 509 also contains memory for recording historical information of the packets dropped in a previous frame which is used to compute the next packets to drop. This enables avoiding repetitive removal of identical spatial areas of a scene.

[0029] The bitrate regulation module 511 produces an output which is compatible with the capabilities of a receiving terminal as indicated by the feedback signal 507 coupled to input to the main bitstream controller 505. The output of the bitrate regulation module 511 is coupled to the input of the replacement tag generator 515, which is a means for inserting predetermined bits to improve the decoding of the bitstream in accordance with the standard type and syntax determined in the unit 503. In particular, the replacement tag generator 515 replaces bits dropped by the bitrate regulation module 509 with short code words designed to preserve timing and spatial information in any decoder such that it will not suffer from unrecoverable errors.

[0030] The output of the main bitstream controller

505 is coupled to a heterogeneous network 519, which in turn delivers a resultant bitstream 517 to a robust decoder at a receiving terminal 521. The device 500 is capable of manipulating bitstreams generated by any video coding standard. Depending on the degree of flexibility of the particular standard, varying degrees of functionality in terms of bitrate regulation and error robustness are achieved. In general, the most recent standards, H.263 and MPEG-4, can provide for the most fine control of these bitstream attributes by the device 500.

[0031] Although exemplary embodiments are described above, it will be obvious to those skilled in the art that many modifications and alterations to this method and device for bitstream control and delivery may be made without departing from the invention. Accordingly, it is intended that all such modifications and alterations be included within the spirit and scope of the invention as defined in the following claims.

Claims

1. A method for manipulating bits in a bitstream of encoded video data, said method comprising the steps of:

   determining a standard type and a syntax used to compress the bitstream;
   inserting predetermined bits into the bitstream and translating predictively coded information resulting in an intermediate bitstream with improvement of error robust localization and decoding of the bitstream in accordance with the standard type and the syntax; and
   discarding selected bits from the intermediate bitstream based on the standard type and the syntax used to compress the bitstream resulting in an output bitstream having a bitrate compatible with that of a robust receiving terminal.

2. The method of Claim 1 wherein the step of determining standard type and a syntax used to compress the bitstream further comprises the step of:

   reading header bits; and
   comparing said bits to a predetermined list of standard headers to identify a present standard type and syntax used to compress the bitstream.

3. The method of Claim 1 wherein the step of inserting predetermined bits and translating predictively coded information further comprises the step of:

   inserting resynchronization markers; and
   translating differentially encoded motion vectors and associated texture data parameters to limit predictive coding to within a video packet.

4. The method of Claim 1 wherein said step of discarding selected bits further comprises the step of:

   discarding low priority bits associated with frames in an enhancement layer of a scalable bitstream.

5. The method of Claim 1 wherein said step of discarding selected bits further comprises the step of:

   discarding packets of low priority bits associated with segments in a packet of video bits delimited by resynchronization markers or picture headers.

6. The method of Claim 5 wherein the step of discarding packets of low priority bits further comprises the step of:

   selecting packets to discard on the basis of historical information of packets dropped in a previous frame to avoid repetitive removal of identical spatial areas of a scene.

7. A device for manipulating bits in a bitstream of encoded video data, said device comprising:

   means for determining a standard type and a syntax used to compress the bitstream;
   means for inserting predetermined bits into the bitstream and translating predictively coded information resulting in an intermediate bitstream with improvement of error robust localization and decoding of the bitstream in accordance with the standard type and the syntax; and
   means for discarding selected bits from the intermediate bitstream based on the standard type and the syntax used to compress the bitstream resulting in an output bitstream having a bitrate compatible with that of a robust receiving terminal.

8. The device of Claim 7 wherein said means for determining a standard type and a syntax used to compress the bitstream further comprises:

   means for reading header bits and comparing said bits to a predetermined list of standard headers to identify a present standard type and syntax used to compress the bitstream.

9. The device of Claim 7 wherein said means for inserting predetermined bits and translating predictively coded information further comprises:

   means for inserting resynchronization markers and translating differentially encoded motion

vectors and associated texture data parameters to limit predictive coding to within a video packet.

10. The device of Claim 7 wherein said means for discarding selected bits further comprising:

means for discarding low priority bits associated with frames in an enhancement layer of a scalable bitstream.

11. The device of Claim 7 wherein said means for discarding selected bits further comprising:

means for discarding packets of low priority bits associated with segments in a packet of video bits delimited by resynchronization markers or picture headers.

12. The device of Claim 11 wherein the means for discarding packets of low priority bits further comprises:

means for selecting packets to discard based on historical information of packets dropped in a previous frame to avoid repetitive removal of identical spatial areas of a scene.

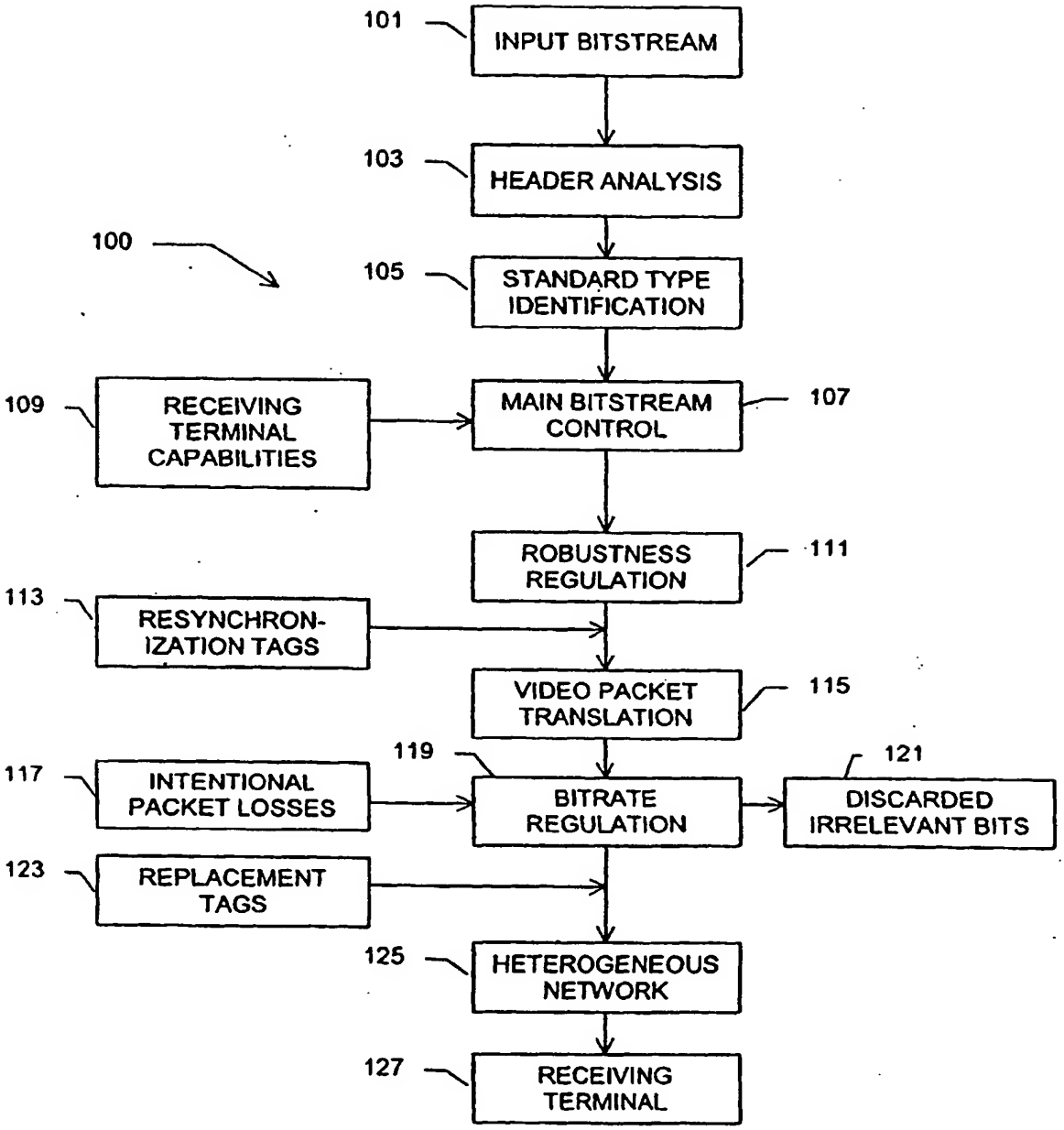

FIG 1

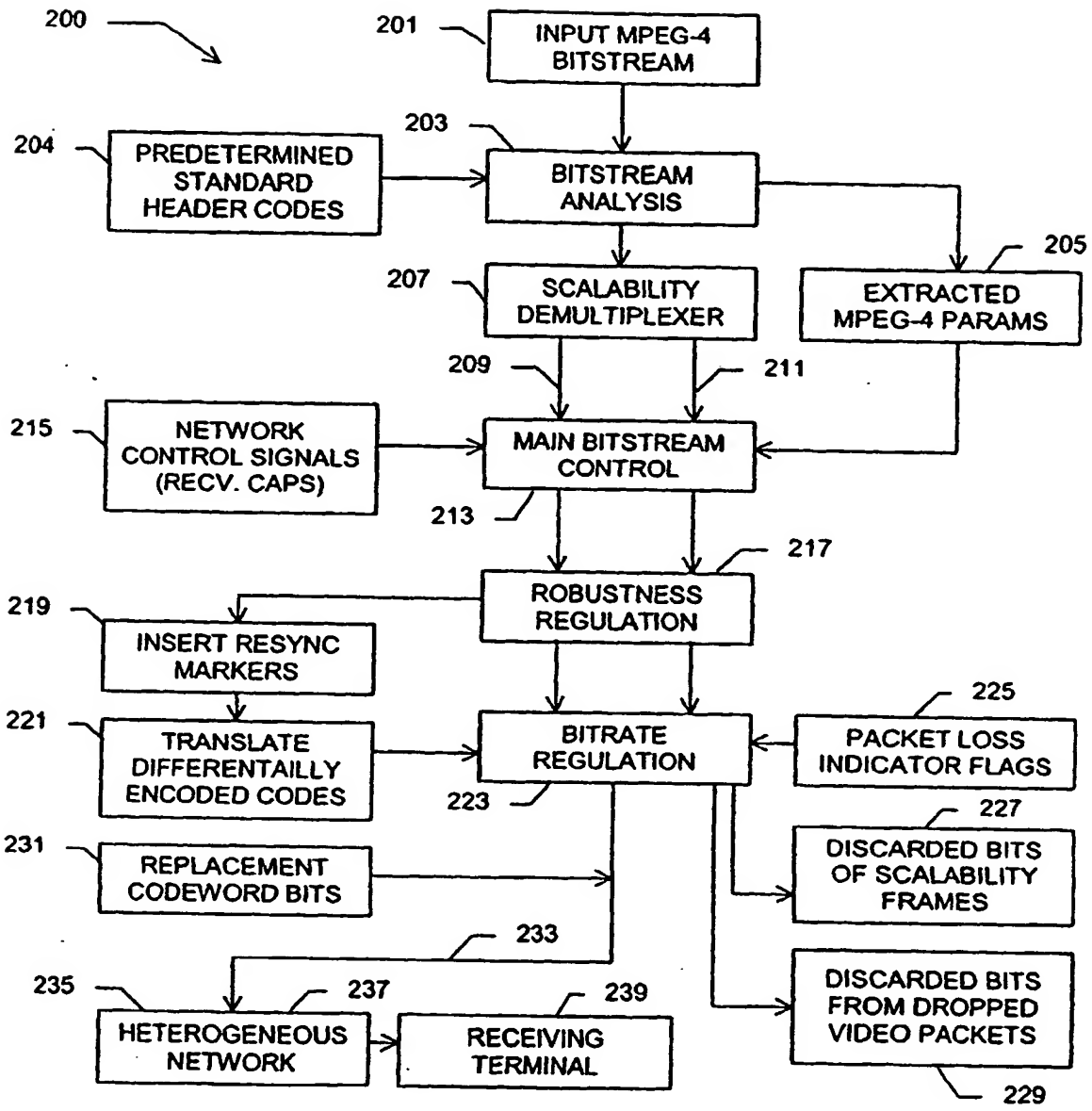

FIG 2

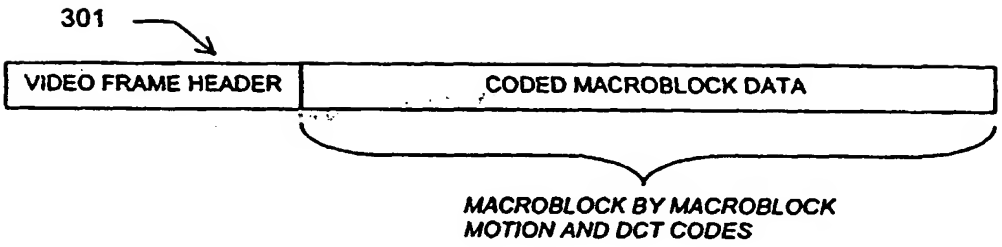

FIG 3A

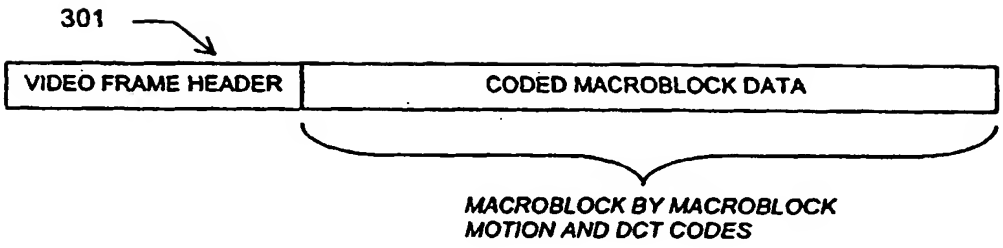

FIG 3A

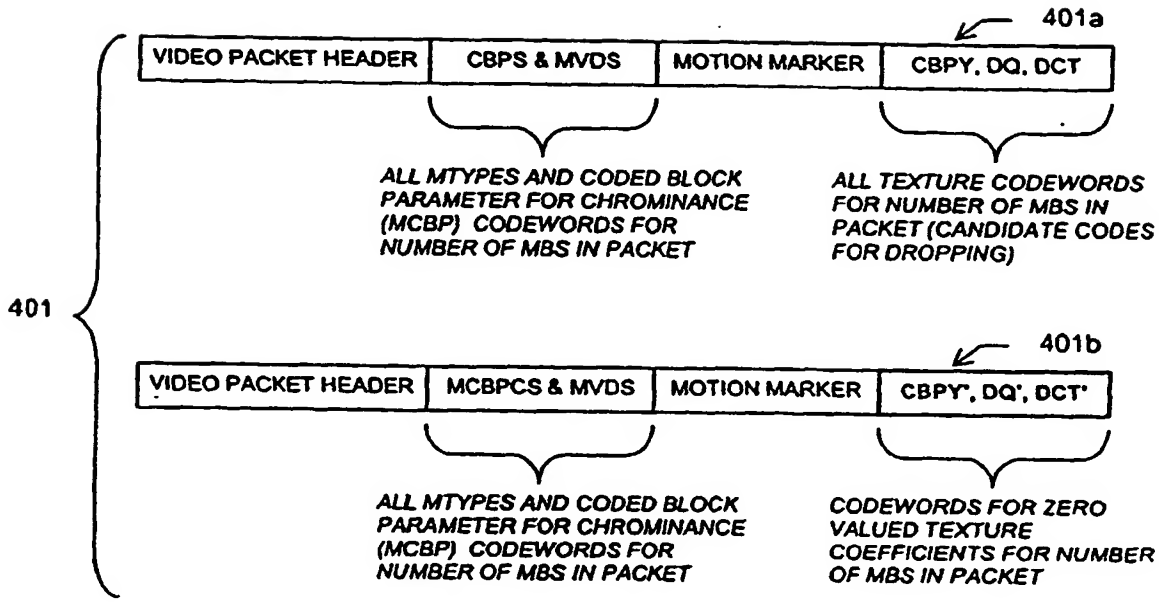

FIG 4A

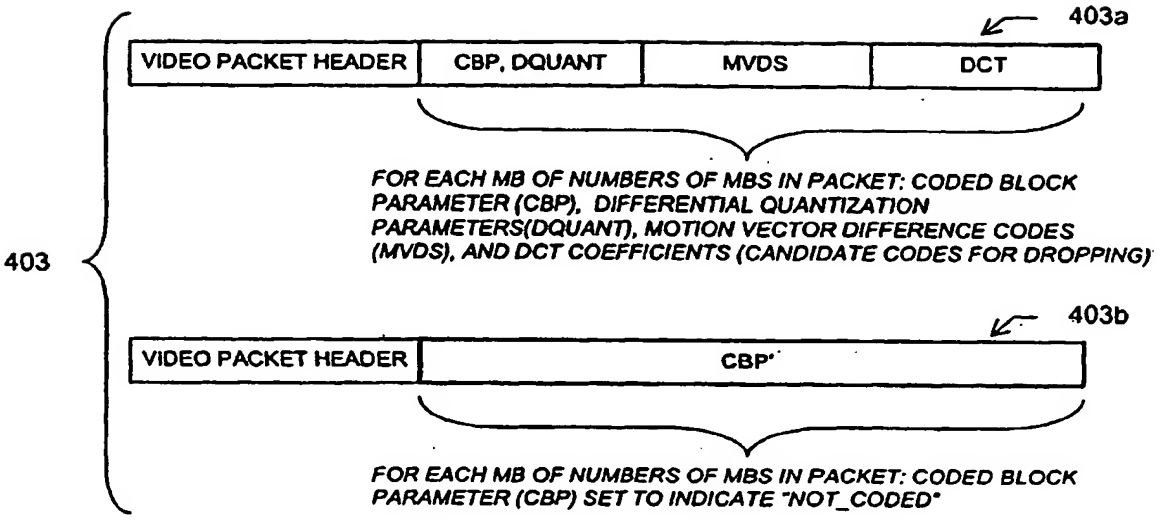

FIG 4B

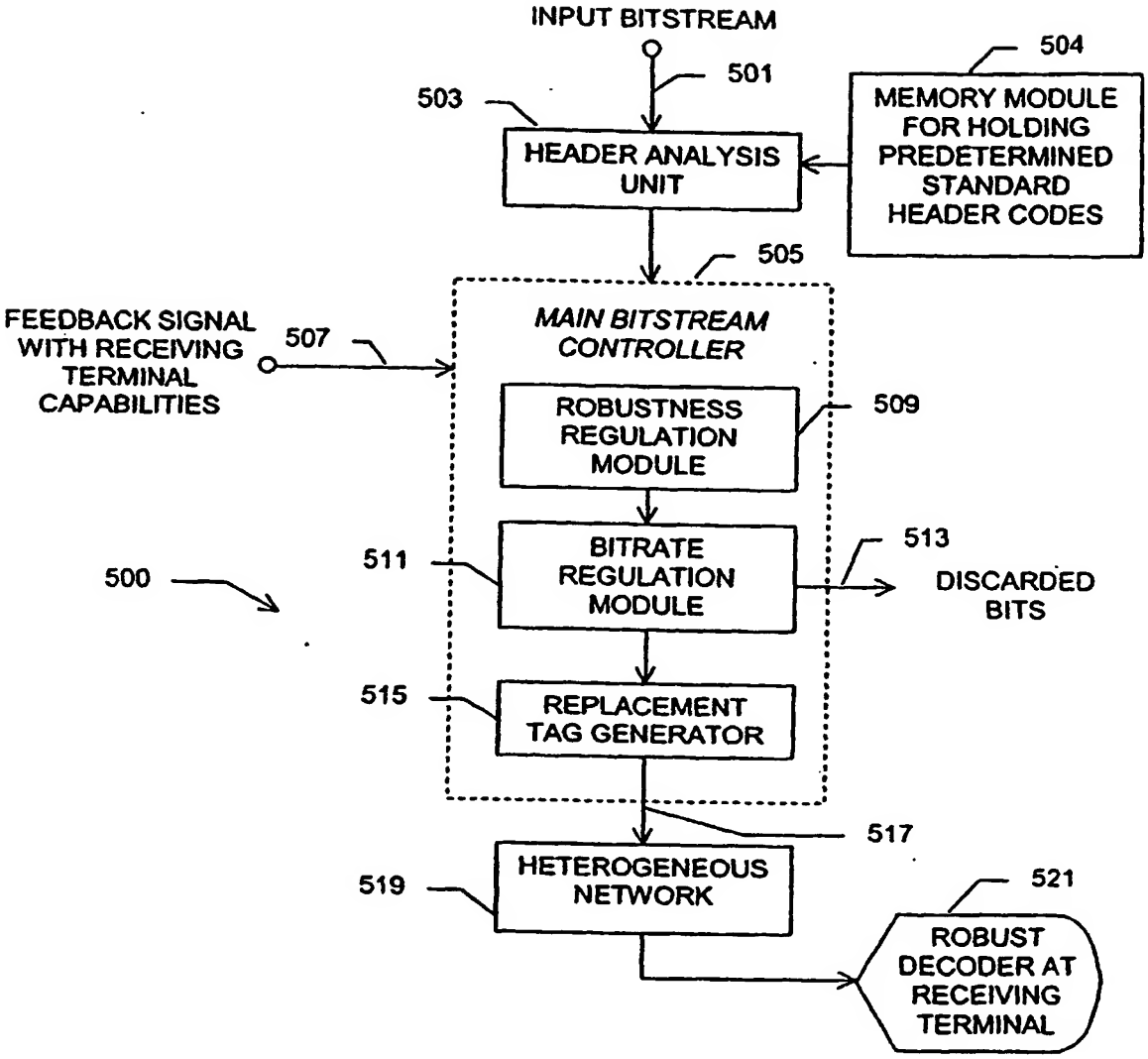

FIG 5

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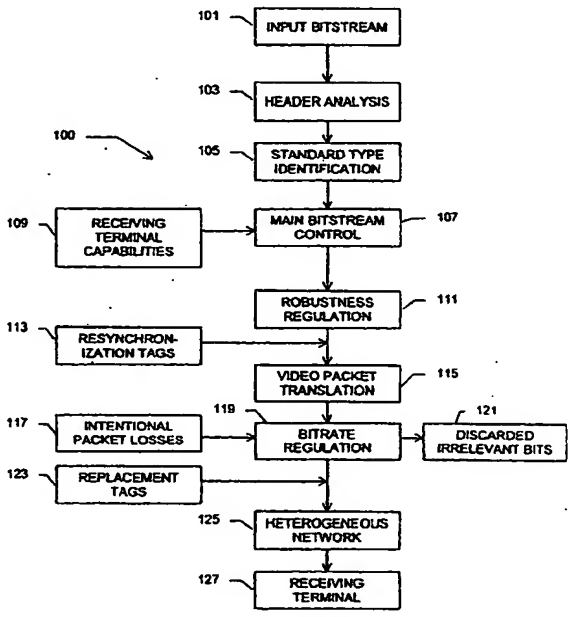

FIG 1

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 30 0597

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
T	MARGENSTERN M: "Frontier between decidability and undecidability: a survey" THEORETICAL COMPUTER SCIENCE ELSEVIER NETHERLANDS, vol. 231, no. 2, 28 January 2000 (2000-01-28), pages 217-251, XP002308666 ISSN: 0304-3975 * section 2.2. The word problem *	1,2,7,8	H04N7/24 H04N7/26 H04N7/64
X	HASKELL P ET AL: "Resynchronization of motion compensated video affected by ATM cell loss" DIGITAL SIGNAL PROCESSING 2, ESTIMATION, VLSI. SAN FRANCISCO, vol. 5-17, 23 March 1992 (1992-03-23), pages 545-548, XP010058890 ISBN: 0-7803-0532-9 * abstract * * page 545, right-hand column, line 25 - line 38 * * page 546, left-hand column, line 32 - right-hand column, line 10 * * page 546, right-hand column, line 45 - line 46 * * figures 1-4 *	1-12	TECHNICAL FIELDS SEARCHED (Int.Cl.7) H04N
A	US 5 812 760 A (GOZU MANABU ET AL) 22 September 1998 (1998-09-22) * abstract * * column 9, line 23 - line 25 * * column 9, line 40 - line 43 * * column 9, line 56 - column 10, line 17 * * figure 5 *	1,2,7,8	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	3 December 2004	Sampels, M

CATEGORY OF CITED DOCUMENTS

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EUROPEAN SEARCH REPORT

Application Number
EP 00 30 0597

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 5 140 417 A (FUSE MASARU ET AL) 18 August 1992 (1992-08-18) * abstract * * column 3, line 20 - line 24 * * column 3, line 49 - line 54 * * column 9, line 23 - line 34 * * column 10, line 12 - line 23 * * claim 1 *	1,2,4,5, 7,8,10, 11	
A	EP 0 631 442 A (MATSUSHITA ELECTRIC IND CO LTD) 28 December 1994 (1994-12-28) * column 1, line 5 - line 10 * * column 3, line 15 - line 20 * * column 4, line 9 - line 19 * * column 4, line 39 - line 45 * * column 4, line 56 - column 5, line 2 *	3,9	
A	US 5 793 895 A (CHANG YUAN-CHI ET AL) 11 August 1998 (1998-08-11) * the whole document *	6,12	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	US 5 726 711 A (BOYCE JILL MACDONALD) 10 March 1998 (1998-03-10) * abstract * * column 2, line 37 - line 43 * * column 3, line 30 - line 37 * * column 4, line 20 - line 24 * * column 4, line 39 - line 53 * * column 5, line 46 - line 50 * * column 6, line 8 - line 14 * * column 6, line 33 - line 49 * * column 7, line 13 - line 33 * * figure 1 *	3,6,9,12	
A	EP 0 853 407 A (DIGITAL VISION LAB CORP) 15 July 1998 (1998-07-15) * abstract * * column 3, line 14 - line 47 *	4,5,10, 11	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	3 December 2004	Sampels, M

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03-12-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5812760 A	22-09-1998	NONE	
US 5140417 A	18-08-1992	JP 3022735 A	31-01-1991
		JP 3022736 A	31-01-1991
		JP 3022780 A	31-01-1991
EP 0631442 A	28-12-1994	JP 7030896 A	31-01-1995
		DE 69419842 D1	09-09-1999
		DE 69419842 T2	16-12-1999
		EP 0631442 A2	28-12-1994
		US 5715005 A	03-02-1998
US 5793895 A	11-08-1998	NONE	
US 5726711 A	10-03-1998	US 5778143 A	07-07-1998
		US 5805762 A	08-09-1998
		US 6262770 B1	17-07-2001
		US 5717816 A	10-02-1998
		US 5887115 A	23-03-1999
		US 5729648 A	17-03-1998
		US 5673358 A	30-09-1997
		US 6023553 A	08-02-2000
		US 5923814 A	13-07-1999
EP 0853407 A	15-07-1998	JP 3193947 B2	30-07-2001
		JP 10200494 A	31-07-1998
		EP 0853407 A2	15-07-1998
		US 6222841 B1	24-04-2001

EPO FORM P0459

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